Tule elk at Concord Naval Station. *Photo © Gary Cottle*

Poplars are used to regulate groundwater levels at Beale Airforce Base which helps prevent contaminated groundwater from entering streams.

Coastal sage scrub and patches of sand dune habitat at Vandenburg Air Force Base.

Fish and wildlife thrive in areas around many of California's military bases. Beale and Mather Air Force bases exist alongside vernal pools with beautiful springtime floral displays, and the Concord Naval Weapons Station shares space with tule elk and tidal marshes. Almost all of California's habitat types can be found near California's military facilities, including riparian, coastal sage scrub, maritime chaparral, and desert. The coexistence of habitat and military operations reflects responsible stewardship balancing resources with the needs of National Security.

By Frank Gray

Military bases began closing in California after Congress passed the Base Realignment and Closure Act (BRAC) in 1988. Since that time, a total of 24 major California bases have closed during four rounds of closures, about 25 percent of all closures to date nationwide. Still more bases deemed surplus or obsolete will close, and realignment of federal functions at designated bases will also occur. As bases close and realignment occurs, questions rise about the status and future of the natural resources in relation to the existence of possible toxic contamination, where contamination occurs, what human health issues exist, and how we will preserve open space and the environment.

Through the BRAC process bases are converted to commercial, recreational, residential, open space, and other non-military uses. Many base reuse plans are being developed to facilitate this process, and some contain elements for long-term protection of various habitat types. As these plans develop, careful consideration is given to current site conditions, and the future uses in terms of chemical contamination.

Contamination of soil, sediments, and surface and groundwater at bases has existed for decades, posing human health and ecological risks. Sources have included firing ranges, landfills, training areas, airfields, scrap yards, treated and untreated wastewater, maintenance areas, fuel storage tanks, and even some from offsite. These sources have resulted in the environmental release of solvents, paints, petroleum hydrocarbons, polychlorinated bi-

Valuable riparian habitat at Beale Airforce Base.

Coastal sage scrub, riparian and freshwater emergent/aquatic habitat at Vandenburg Air Force Base.

Photos from DFG-OSPR files

At Fort Ord Army Base near Monterey, coastal scurb habitat is periodically burned.

The kangaroo rat is just one of many endangered species that inhabit the various military bases in California.

Burning the area facilitates ordnance removal and rejuvenates the habitat.

Photos from DFG-OSPR files

phenyls, heavy metals, pesticides, ammunition wastes, explosives, and other substances. Depending on a variety of factors, some contaminants may become widely distributed on a base, contaminating wetlands and other habitats.

Many species of fish and wildlife, as well as plants, surface waters, and other habitat elements, are at risk at or near contaminated sites. Potential pathways for exposure of organisms to contaminants include ingestion of contaminated soil and/or water, consumption of other plants and animals in the food chain, absorption through the skin, and absorption through inhalation. Animals with small home ranges may spend their entire lives at a contaminated site and may receive a greater exposure. Military facilities in California are known to host endangered species like the salt marsh harvest mice, clapper rail, fairy shrimp, and California least tern. Other listed or otherwise sensitive species include California black rail, burrowing owl, peregrine falcons, and various native fish species. Listed plant species are also often present in addition to many non-threatened species like elk, deer, fish and a variety of birds.

Applicable state and federal laws and regulations guide and authorize the Department of Fish and Game (DFG) to address some of the resource concerns associated with contaminated military sites in California. Until the late 1970s, few laws addressed hazardous waste disposal. In 1980, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) passed, and it governs each phase of the remediation or "cleanup" process. Also known as the Superfund law, CERCLA mandates an eight-step cleanup process that is applicable at closed and active military bases, as well as non-military contaminated sites. DFG, through the Resources Agency, was designated as a CERCLA co-trustee for natural resources in 1993. This designation gives DFG a direct mechanism to provide guidance and cleanup standards to the military for the protection of fish and wildlife species. DFG shares the trustee and oversight status with California Department of Toxic Substances Control and State Water Resources Control

The topography at Vandenburg Air Force Base consists of altering sand dunes and depressions (swales), along with shallow ponds fringed by emergent vegetation and willows.

Coastal sage scrub habitat near a missile launch complex at Vandenburg Air Force Base in Santa Barbara County.

Fort Ord habitat before and after burn.

Least terns are another species that can be found on military property in California. *Photo from DFG files*

Board. Participating federal agencies (in addition to the Department of Defense) include the U.S. Environmental Protection Agency (lead federal agency) and U.S. Fish and Wildlife Service.

DFG began its program in 1995 under the Office of Spill Prevention and Response in Sacramento. Two biologists and three toxicologists make up the core of the program. They evaluate ecological risk assessments and subsequent cleanup plans prepared by the military's contractors at each base. DFG BRAC biologists identify potential species and habitats that occur at bases, and help ensure that contractors perform the appropriate resource surveys. They also assist toxicologists in identifying fish and wildlife species that are very susceptible to chemical contamination and so would be suitable for use in studies on ecological risk for a given site. BRAC toxicologists review base contaminant analysis data and toxicity screening criteria, advise on testing and sampling procedures, and interpret risk assessment results. Efforts focus on determining whether unacceptable levels of ecological risk exist due to the presence of contaminants, and making recommendations that protect fish and wildlife for any required cleanup action. DFG's BRAC unit coordinates its cleanup recommendations with the other participating agencies, as well as with other functions of the DFG.

Photos from DFG-OSPR files

The recommendations may be part of the cleanup plan or part of the conversion plan. At the former Norton Air Force Base habitat exists for the federally endangered San Bernadino kangaroo rat and Santa Ana wooly star plant. The kangaroo rat will be protected during the cleanup process by placement of exclusionary fencing and regular monitoring. At Fort Ord Army Base near Monterey, a multispecies habitat management plan has been developed that provides for preservation and restoration of habitat for designated species, while also allowing orderly development of other parts of the base under the base reuse plan.

In addition to contaminants, cleanup activities themselves can cause varying degrees of environmental harm. At stake are wetlands, riparian areas, and other habitats. These may be subject to physical disturbances during a removal process or contamina-

Pickleweed and freshwater habitats provide habitat for salt marsh harvest mice and black rails at Concord Naval Weapons Station in Contra Costa County.

Above, salt marsh harvest mouse. An endangered species in California. Below, tule elk at Concod Naval Weapons Station.

Photos from DFG files

Photo © Alyce Pagano

Clapper rails and black rails can be found on military property in California.

tion as a result of leaks in a contamination barrier. Excavation and removal of contaminated soil or sediment at military sites is usually only done at sites of relatively high contamination known as hotspots. Materials are often left in place and monitored over time. In some scenarios, an earthen cap measuring from a few inches to two or more feet in depth is placed over the fill material. Other barriers or chemical treatments may be needed at a given site to prevent spread of contaminants over the area or down to groundwater. One of the most promising types of in place remediation is "phytoremediation" which involves the planting or retention of trees and other plants to reduce in situ soil or sediment contaminant levels. Metabolic processes of some plants convert contaminants to less toxic forms.

DFG's BRAC program is involved with a total of 38 Navy and Marine Corps facilities, and 56 Army and Air Force facilities. These range in size from sites of only a few acres to bases as large as 1,088,000 acre like China Lake Naval Weapons Station. The sites include both closing and active bases where cleanup is required. Participation by communities on a local level is integral to the decision making process. Restoration Advisory Boards provide input to the cleanup efforts at individual bases, and are staffed by representatives of the applicable military branch, the regulatory agencies, and local citizens who may represent a variety of interests and concerns.

In the end, the communities and the natural resources benefit from BRAC.

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